

IN THE CLAIMS:

Claims 1 - 23 (Non-elected, with Traverse)

24. (Currently Amended) A direct oxidation fuel cell, comprising:

(A) a membrane electrode assembly disposed within a fuel cell housing, including

(i) a protonically conductive, electronically non-conductive membrane electrolyte having an anode face and an opposing cathode face;

(ii) an anodic metallic diffusion layer disposed generally parallel to said anode face of said membrane electrode assembly and having a plurality of openings therein, [to allow] said openings being of a size so as limit mass transport of an associated fuel substance [to pass] therethrough to said anode face of said membrane electrode assembly to produce [said] electricity generating reactions [and to allow electrons] and to allow the mass transport of carbon dioxide produced in said reactions [to travel] away from said membrane electrode assembly;

(iii) an anode catalyst disposed generally between said anode face and said anodic metallic diffusion layer, and a cathode catalyst disposed generally between said cathode face of the protonically conductive, electronically non-conductive membrane electrolyte, and a cathode side of said housing, whereby electricity-generating reactions occur upon introduction of said associated fuel substance including anodic disassociation of said fuel substance into carbon dioxide, protons and electrons, and a cathodic combination of protons, electrons and oxygen from an associated source of oxygen, producing water; and

(B) a load coupled across an anode and cathode of said fuel cell, providing a path for said electrons produced at the anode by said electricity-generating reactions, to the cathode.

1 25. (Previously Added) The direct oxidation fuel cell as defined in claim 24
2 wherein
3 said openings in said anodic metallic diffusion layer comprise a plurality of pores
4 formed in said anodic metallic diffusion layer.

1 26. (Previously Added) The direct oxidation fuel cell as defined in claim 24
2 wherein said anodic metallic diffusion layer comprises a porous metal that has openings
3 therein to allow substances to pass through said openings.

1 27. (Previously Added) The direct oxidation fuel cell as defined in claim 24
2 wherein said anodic metallic diffusion layer is at least partially comprised of at least one
3 of titanium, chromium, stainless steel and other alloys, or combinations thereof.

1 28. (Previously Added) The direct oxidation fuel cell as defined in claim 24
2 wherein said anodic metallic diffusion layer is at least partially comprised of a metallic
3 material that does not substantially react with methanol, or other reactants and by prod-
4 ucts of the electricity generating reactions.

1 29. (Currently Amended) The direct oxidation fuel cell as defined in claim 24
2 wherein
3 said anodic metallic diffusion layer comprises a composition of [loose] pieces of
4 metal bonded together that have spaces therebetween allowing substances to pass be-
5 tween the interstices formed by said spaces between metal pieces. ,

1 30. (Currently Amended) The direct oxidation fuel cell as defined in claim 24
2 wherein said anodic metallic diffusion layer is treated with a substance that renders at
3 least a portion of the anodic metallic diffusion layer at least partially hydrophobic to con-
4 trol the flow of water while allowing the flow of gases.

1 31. (Currently Amended) The direct oxidation fuel cell as defined in claim 24
2 wherein said anodic metallic diffusion layer is treated with a substance that renders at
3 least a portion of the anodic metallic diffusion layer at least partially hydrophilic to en-
4 courage the flow of at least one of fuel and water.

1 32. (Currently Amended) The direct oxidation fuel cell as defined in claim 24
2 wherein said anodic metallic diffusion layer is treated with a substance that renders a first
3 portion of the layer hydrophobic and a second portion of the layer hydrophilic, to allow
4 for the flow of water and fuel and the flow of gases in proportion to the portion that is
5 hydrophilic and hydrophobic, respectively, throughout the anodic metallic diffusion
6 layer.

1 33. (Previously Added) The direct oxidation fuel cell as defined in claim 25
2 wherein said pores are of more than one dimension.

1 34. (Previously Added) The direct oxidation fuel cell as defined in claim 33
2 wherein a group of said pores formed in said anodic metallic diffusion layer are of a
3 larger size than a remaining group of said pores, and at least some of the pores of said
4 larger size are treated with a hydrophilic material.

1 35. (Previously Added) The direct oxidation fuel cell as defined in claim 34
2 wherein at least some of said remaining group of pores are treated with a hydrophobic
3 material.

1 36. (Currently Amended) The direct oxidation fuel cell as defined in claim 33
2 wherein at least some of said pores of said layer are treated with [Nafion], NAFION® or
3 a substance that renders treated pores at least partially hydrophilic.

1 37. (Currently Amended) The direct oxidation fuel cell as defined in claim 33
2 wherein at least some of said pores of said layer are treated with [Teflon], TEFLON® or
3 other hydrophobic agent to render treated pores at least partially hydrophobic.

1 38. (Currently Amended) The direct oxidation fuel cell as defined in claim 29
2 wherein said [loose] pieces of metal are bonded together by particle diffusion bonding
3 techniques.

1 39. (Previously Added) The direct oxidation fuel cell as defined in claim 38
2 wherein said particles are treated by at least one of a hydrophobic substance and a hydro-
3 philic substance.

1 40. (Previously Added) The direct oxidation fuel cell as defined in claim 24,
2 wherein a first portion of said layer is treated with a hydrophobic substance, and a second
3 portion of said layer is treated with a hydrophilic substance, to form a pattern in said me-
4 tallic diffusion layer of areas of relative hydrophobicity and areas of relative hydrophilic-
5 ity, to provide discrete paths through the metallic diffusion layer through which gaseous
6 and liquid reactants and byproducts can pass.

1 41. (Previously Added) The direct oxidation fuel cell as defined in claim 24, further
2 comprising:

3 a flow field plate disposed generally parallel to said anodic metallic diffusion
4 layer, said flow field plate having channels formed therein to direct the flow of sub-
5 stances within said fuel cell across said anodic metallic diffusion layer.

1 42. (Previously Added) The direct oxidation fuel cell as defined in claim 24
2 wherein

3 said anodic metallic diffusion layer performs as a flow field plate and current
4 collector to conduct electrons produced in said electricity generating reactions and said

5 load being coupled to said anodic metallic diffusion layer to provide a path for said elec-
6 trons out of said fuel cell as the electricity is produced by said fuel cell.

1 43. (Previously Added) The direct oxidation fuel cell as defined in claim 42
2 wherein

3 said anodic metallic diffusion layer performing as said flow field plate and current
4 collector includes channels formed therein to direct the flow of fuel to said anode face of
5 said membrane electrode assembly.

1 44. (Currently Amended) The direct oxidation fuel cell as defined in claim 24 further
2 comprising

3 a cathodic metallic diffusion layer disposed generally parallel to said cathode face
4 of said membrane electrode assembly and having a plurality of openings therein, said
5 openings being sized to limit the transport of oxygen to said cathode face [to allow oxy-
6 gen to pass therethrough to said cathode face] of said membrane electrode assembly, and
7 to control water in said fuel cell, [to travel away from said membrane electrode assem-
8 bly].

1 45. (Currently Amended) The direct oxidation fuel cell as defined in claim 44
2 wherein

3 said openings in said cathodic metallic diffusion layer comprise a plurality of
4 pores formed in said cathodic metallic diffusion layer, said pores being sized to limit the
5 water released from the cathode aspect of the fuel cell.

1 46. (Currently Amended) The direct oxidation fuel cell as defined in claim 44
2 wherein

3 said cathodic metallic diffusion layer comprises a porous metal that has openings
4 therein that allow substances to pass through said openings, said openings being sized to
5 limit the water that is released from the cathode aspect of the fuel cell.

1 47. (Previously Added) The direct oxidation fuel cell as defined in claim 44
2 wherein

3 said cathodic metallic diffusion layer comprises a porous metal that has openings
4 therein that allow removal of liquids from, and allow introduction of gases to the mem-
5 brane electrode assembly.

1 48. (Currently Amended) The direct oxidation fuel cell as defined in claim 44
2 wherein said cathodic metallic diffusion layer is at least in part comprised of a material
3 selected from the group consisting of nickel, copper, titanium, chromium, steel, stainless
4 steel, and other [suitable] alloys and combinations thereof.

1 49. (Previously Added) The direct oxidation fuel cell as defined in claim 44
2 wherein said cathodic metallic diffusion layer is at least in part comprised of a material
3 that does not substantially react with byproducts or substances, present on the cathode of
4 the fuel cell.

1 50. (Currently Amended) The direct oxidation fuel cell as defined in claim 44
2 wherein
3 said cathodic metallic diffusion layer comprises a composition of [loose] pieces of
4 metal bonded together that have spaces therebetween allowing substances to pass through
5 the interstices formed by said spaces between said metal pieces, the spaces being sized to
6 control the flow of water in said fuel cell.

1 51. (Previously Added) The direct oxidation fuel cell as defined in claim 44
2 wherein said cathodic metallic diffusion layer is treated with a substance that renders the
3 layer at least partially hydrophobic, to allow the introduction of gases to the membrane
4 electrode assembly.

1 52. (Previously Added) The direct oxidation fuel cell as defined in claim 44
2 wherein said cathodic metallic diffusion layer is treated with a substance that renders the

3 layer at least partially hydrophilic, to allow the removal of liquids from the cathode face
4 of the membrane electrode assembly.

1 53. (Currently Amended) The direct oxidation fuel cell as defined in claim 44
2 wherein said cathodic metallic diffusion layer is treated with a first substance that renders
3 a first portion of the cathodic metallic diffusion layer hydrophobic and a second sub-
4 stance that renders a second portion of the cathodic metallic diffusion layer hydrophilic,
5 to balance the flow of water and the flow of gases throughout the cathodic metallic diffu-
6 sion layer.

1 54. (Previously Added) The direct oxidation fuel cell as defined in claim 44 further
2 comprising a second flow field plate that is disposed generally parallel to said cathodic
3 metallic diffusion layer.

1 55. (Previously Added) The direct oxidation fuel cell as defined in claim 44
2 wherein
3 said cathodic metallic diffusion layer performs as a flow field plate and current
4 collector, and said load being coupled to said cathodic metallic diffusion layer to provide
5 a path for electrons to travel to the cathode where it combines with oxygen at said cath-
6 ode side of said fuel cell, producing water.

1 56. (Previously Added) The direct oxidation fuel cell as defined in claim 55
2 wherein
3 said cathodic metallic diffusion layer performing as said flow field plate and cur-
4 rent collector has channels formed therein to direct the flow of oxygen across the cathode
5 face of said membrane electrode assembly.

1 57. (Previously Added) The direct oxidation fuel cell as defined in claim 24
2 wherein said anodic metallic diffusion layer is at least in part comprised of a material
3 having properties that improve conductivity.

1 58. (Previously Added) The direct oxidation fuel cell as defined in claim 24
2 wherein said anodic metallic diffusion layer is treated or coated with a material to provide
3 improved conductivity.

1 59. (Previously Added) The direct oxidation fuel cell as defined in claim 44
2 wherein said cathodic metallic diffusion layer is at least in part comprised of a material
3 having properties that improve conductivity.

1 60. (Previously Added) The direct oxidation fuel cell as defined in claim 24
2 wherein said cathodic metallic diffusion layer is treated or coated with a material to provide improved conductivity.

1 61. (Previously Added) The direct oxidation fuel cell as defined in claim 24
2 wherein
3 said fuel substance is a liquid carbonaceous fuel substance.

1 62. (Previously Added) The direct oxidation fuel cell as defined in claim 24
2 wherein
3 said fuel substance is selected from the group consisting of methanol, ethanol,
4 propanol, butanol and aqueous solutions thereof and combinations thereof.

Claims 63-110 (Non-Elected, with Traverse).

1 111. (New) The direct oxidation fuel cell as defined in claim 24 further comprising:
2 an additional layer, disposed between said anodic metallic diffusion layer
3 and said anode catalyst, of at least one of the following:
4 (i) carbon paper; and
5 (ii) carbon cloth.

- 1 112. (New) The direct oxidation fuel cell as defined in claim 44 further comprising:
2 an additional layer, disposed between said cathodic metallic diffusion
3 layer and said cathode catalyst, of at least one of the following:
4 (i) carbon paper; and
5 (ii) carbon cloth.
- 1 113. (New) The direct oxidation fuel cell as defined in claim 44 wherein said cathodic
2 metallic component is substantially hydrophilic.